# Lab: Hot and Cold Packs

You are probably familiar with the use of hot or cold packs in sports medicine. Someone might injure themselves and then put an instant hot pack or cold pack against the injury. Reusable hot and cold packs can also be used for keeping food cold or keeping hands warm in the winter. In this lab, you will investigate the enthalpy of solution of a substance and determine its suitability for use in a hot or cold pack, or neither.

  
You will be provided with ~10 grams of an unknown substance which you will test, using calorimetric techniques, to **determine its enthalpy of solution** and from this data, you must **deduce its identity**.

This lab will have a formal write-up and you will be responsible for designing the experimental procedure to determine the heat transferred when a mass of solid is dissolved in water. Fear not, you already probably have a rough idea of what you will need to do as we have been discussing calorimetry techniques in class. You just need to get it down on paper and formalize it.

Here is a list of possible compounds that you may receive, along with their Enthalpies of Solution.

|  |  |
| --- | --- |
| **Salt** | **Enthalpy of Solution** |
| Ammonium Chloride (NH4Cl) | 0.277kJ/g |
| Potassium Nitrate (KNO3) | 0.345kJ/g |
| Ammonium Nitrate (NH4NO3) | 0.321kJ/g |
| Anhydrous Sodium Acetate (NaC2H3O2) | -0.211kJ/g |
| Sodium Acetate Trihydrate (NaC2H3O2• 3H2O) | 0.144kJ/g |
| Potassium Chloride (KCl) | 0.231kJ/g |
| Sodium Chloride (NaCl) | 0.066kJ/g |
| Calcium Chloride (CaCl2) | -0.669kJ/g |
| Sodium Hydroxide (NaOH) | -1.11kJ/g |
| Magnesium Nitrate (Mg(NO3)2) | -3.70kj/mol = -0.0229kj/g |

If any other possible substances are being used, your teacher will tell you.

You must create a procedure and present it as **numbered steps** in **past passive tense** (e.g. the water was added…) including masses, volumes, specific equipment, and safety information. You will be able to use all the normal lab materials and apparatus for your experiment.

You will also need to show the calculations you will use to determine the identity of the salt. Show all formulas and units that you will use.

NB: You will find it easier to do the calculations and complete your lab if you assign symbols (mwater, Ti, etc.) to each of your measurements that you expect, then create a chart where you can put in the measured values. It will also simplify data collection.

**Before you start the lab, you must have your experimental design (<1 paragraph), procedure, materials & apparatus list, and calculations ready and approved by your teacher. You can edit them afterwards (before submission) but they must be thorough enough before you start the lab.**

After the lab, complete these questions as part of your report in **paragraph form**.

Results

1. Determine the identity of the unknown salt. Show your calculations.
   1. How did your experimental value of enthalpy of solution compare with the actual value for your substance from the table?
2. Express the reaction that occurred in a proper thermochemical equation

Discussion

1. Would your salt have useful applications relating to its enthalpy of solution? If so, what would they be? You can reference current uses as well.
2. Out of the possible unknown chemicals, which would make for the best hot pack and/or best cold pack? How would you know this?
3. Suggest a minimum of 3 sources of EXPERIMENTAL error. Include HOW they would have affected your results (i.e. it would have increased heat of sol’n)
   1. Do not include human error here, but you may make a separate note of it if it markedly affected your results.

Your lab is due \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Present it with a title page and a complete write-up. Remember that calculations are not observations, rather can fall under a separate category of Calculations or in the category of Results. Remember to include a brief introduction to the topic (1-2 paragraphs), perhaps including discussion of hot/cold packs and/or enthalpy.

Affix this page to the back of your lab report.

Lab Evaluation /25

Title/Title Page 0 1

Introduction 0 1 2

Purpose 0 1

Experimental Design 0 1 2 3

Calculations 0 1 2 3

Procedure/Materials 0 1 2 3

Observation (data) Table 0 1 2

Results/Correct Identity of the Salt 0 1 2 3 4

Discussion 0 1 2 3 4 5

Overall neatness and presentation 0 1